





# Thermal Conductivity Comparison of Allcomp versus SGL Material for Tracker Tray Closeout Walls

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5/7/2001

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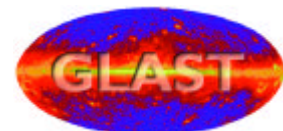
## Abstract

A thermal FEM analysis was done on the GLAST tracker tray closeout walls and the overall tracker tower using thermal conductivities of Allcomp's P30-3D Carbon-Carbon versus SGL's 1501G material. Temperature profiles for heat transport from the MCM electronics board out to the thermal boss that connects to a sidewall was developed for both the standard GLAST trays as well as the GLAST bottom tray. The bottom tray also considered the difference in temperature profile when a thermal gasket material is used in between the tower and the grid versus a rigid connection.

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## Revision Log

<b>Rev.</b>	<b>Date</b>	<b>Author(s)</b>	<b>Summary of Revisions/Comments</b>
-	5/7/2001	Steve Ney	Initial release.

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## 1. Introduction

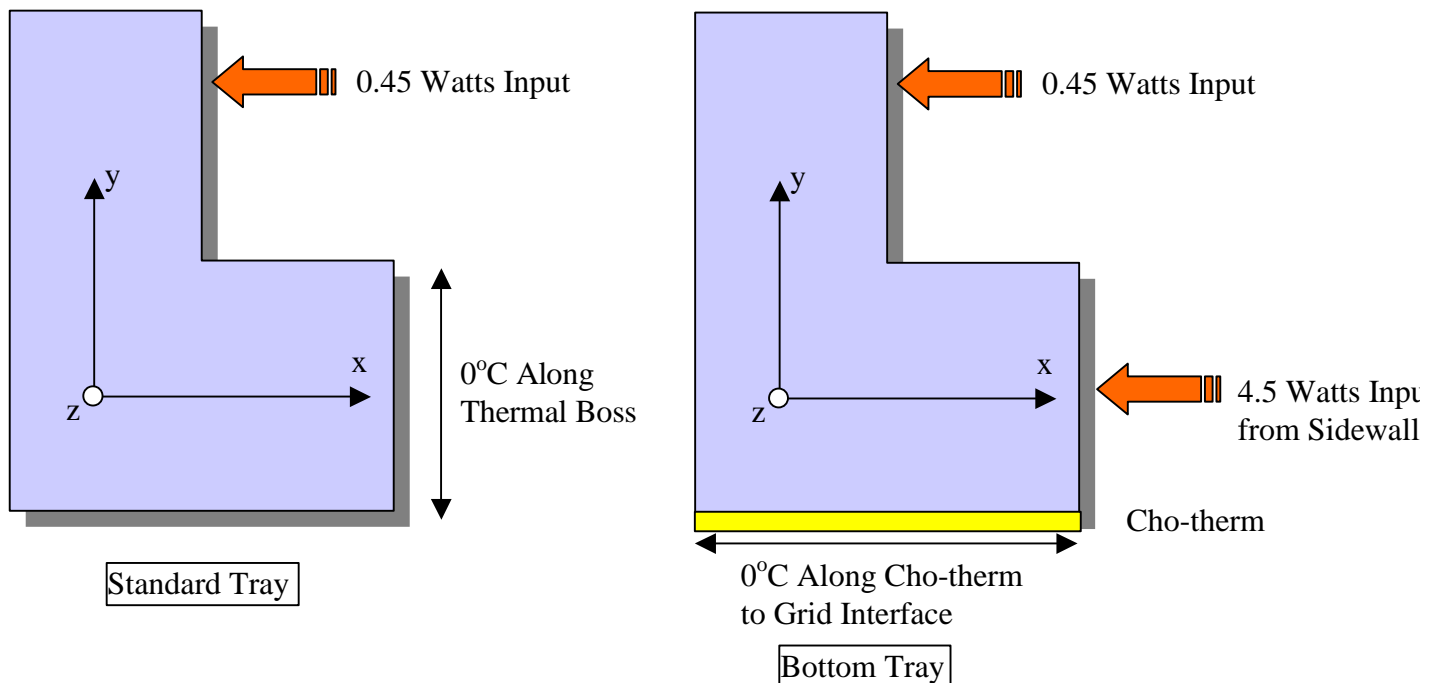
Simple plane 2D models of the standard and bottom GLAST tracker trays were built. Heat input of approximately 0.45 watts was placed along the MCM board and closeout wall interface. A reference temperature of 0°C was set on the thermal boss of the standard tray closeout wall. The upper wall thickness of the closeout wall was varied from 5mm down to 1mm to see how the temperature profile varied with wall thickness.

In the case of the bottom tray, additional elements representing the Cho-therm gasket material were added along the bottom of the thermal boss and a thermal heat input was placed on the thermal boss from the sidewall heat conduction. The wall thickness for the bottom tray was kept constant at 3mm.

The models were then run for the temperature distribution through the closeout wall using the thermal conductivities given for both Allcomp and SGL. Table 1 lists the thermal conductivities for each material along with figure 1, which shows the coordinate system used.

**Table 1. Material Thermal Conductivities**

	Allcomp P30-3D Carbon	SGL 1501G Carbon
Kx (W/m-K)	100	4
Ky (W/m-K)	200	25



**Figure 1. Coordinate System for Thermal Properties.**

## 2. Results

The FE models shown above gave the following results in table 2. A side-by-side comparison of two towers, one built with Allcomp material and one with SGL material for the closeout walls of the trays, would give a difference in temperature profiles of approximately 3°C.

**Table 2. FE Results from Plane 2D Models.**

Standard Mid Tracker Tray								Bottom Tracker Tray			
Wall Thk = 5mm		Wall Thk = 2mm		Wall Thk = 1.5mm		Wall Thk = 1mm		Wall Thk = 3mm W/ cho-therm		Wall Thk = 3mm W/O cho-therm	
Allcomp	SGL	Allcomp	SGL	Allcomp	SGL	Allcomp	SGL	Allcomp	SGL	Allcomp	SGL
0.057 °C	0.73 °C	0.1 °C	1.12 °C	0.124 °C	1.3 °C	0.175 °C	1.76 °C	0.44 °C	2.4 °C	0.143 °C	1.91 °C

To check the FE models a simple analytical calculation was done for the case of a standard tray with wall thickness of 1.5mm. Using the simple conduction equation:

$$\frac{Q}{A} \equiv \frac{k}{x} * (T_i - T_o) \quad \text{Eqn. 2.1}$$

and assuming no internal heat generation along the path of conduction, the initial temperature  $T_i$  becomes a function of the heat input  $Q$ , and the path length. Solving for  $T_i$ , we see that for a standard tray with 1.5mm wall thickness,  $T_i = 0.121^\circ\text{C}$  for Allcomp carbon and  $T_i = 1.28^\circ\text{C}$  for SGL carbon, which agrees very well with the FE model for the standard tray.

## 3. References

1. Chapman, Alan J., *Fundamentals of Heat Transfer*, pg. 34-35, Macmillian publishing, 1987.